ANALYSIS OF LARGE TRUCK ACCIDENTS IN JAPAN

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ABSTRACT

The particularities of accidents involving large trucks (GVW of 8 tons or larger) in Japan and the future direction of applicable safety measures will be examined herein. An analysis of traffic accidents caused by large trucks according to statistical data has especially revealed the involvement of passenger cars and pedestrians. Accidents involving passenger cars are mostly caused by collisions through carelessness (taking one's eyes off the road ahead), and can be reduced by using the collision warning system and the forward collision avoidance assistance system. Accidents involving pedestrians often occur while they are crossing roads at night, and can be lessened by the use of night vision or other nighttime visibility aids.

INTRODUCTION

At present in Japan, overall traffic safety measures are being promoted from the viewpoints of people, the environment, and vehicles. The Ministry of Land, Infrastructure and Transport is actively working with new targets set forth in 1999 for reducing the number of traffic fatalities by 1500 by the year 2010 through vehicle safety measures. Hino Motors, Ltd. has started tackling a new vision of realizing trucks that will ensure safety over a much wider range. For realizing such trucks, it is necessary to extend new safety measures to areas that hitherto have not been considered from the viewpoint of accident prevention. Based on the statistical data from traffic accidents, the particularities of accidents caused by large trucks have been analyzed, and the direction of future safety measures has been examined.

INVESTIGATION

In Japan, as in Europe and the U.S., various measures are deployed with the aim of substantiating the accident investigation system. In 1992, for example, the Institute for Traffic Accident Research and Data Analysis (ITARDA) was established for the acquisition and distribution of statistical data on accidents. The database owned by this institute, which is made up of statistical data on traffic accidents obtained from the National Police Agency and automobile registration data from the Ministry of Land, Infrastructure and Transport, allows analysis of all accidental deaths and injuries from different facets represented by their causes. ITARDA carries out microscopic investigation of approximately 300 accidents per year, thereby providing even more detailed data on accidents. The present study, in which the particularities of accidents involving large trucks are analyzed in terms of the relationship with their causes, is based on the traffic statistics for the year 2000 presented by ITARDA. Large trucks referred to here are deemed to be ones whose gross vehicle weight (GVW) is eight tons or more, fatalities as ones where death occurred within 24 hours of the accident, and injuries include both serious and minor ones. "Accidents attributable primarily to large trucks" are ones where errors on the part of large trucks take up the greater part, i.e., are caused by large trucks. "Accidents attributable secondarily to large trucks" are ones where errors by large trucks take up a smaller part, i.e., in which large trucks are involved. "Accidents concerning large trucks" is the total of "accidents attributable primarily to large trucks" and "accidents attributable secondarily to large trucks".

ANALYTICAL RESULTS

While the number of traffic fatalities has shown a tendency to decrease over the last several years in Japan, the number of injuries tends to increase. The same trend applies to the number of fatalities and injuries where large trucks are concerned, with 1201 fatalities and approximately 27,000 injuries in the year 2000 (See Figure 1). These figures represent 13% of all fatalities and 2.4% of all injuries in traffic accidents. Let's classify them according to the degree of fault by large trucks. The number of fatalities and injuries in accidents attributable primarily to large trucks, i.e., caused by large trucks, was 493 and approximately 20,000 respectively, and those in accidents attributable secondarily to large trucks, i.e., involving large trucks, was 708 and approximately 7,000 (See Figure 2). As for safety measures, priority has been placed on preventive measures for accidents where large trucks play a primary part, and on collision safety measures for accidents where large trucks play a secondary part. As for the latter group, the emphasis is on collision safety measures against passenger car accidents (See Figure 3). Since, for this purpose, a front underrun protector and other countermeasures have already been defined, the present study analyzes only accidents where large trucks play a primary part from the viewpoint of accident prevention.

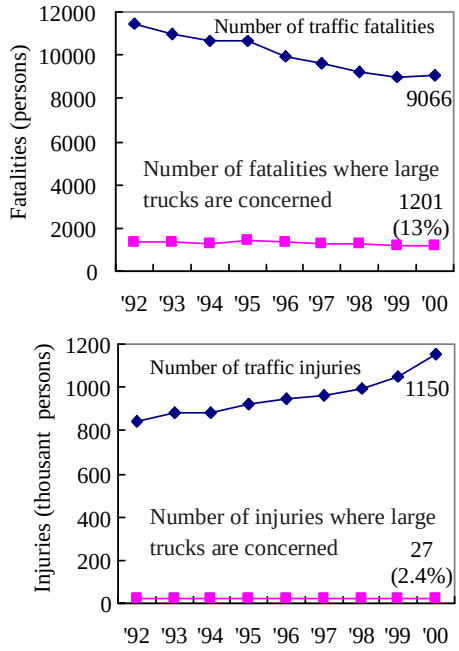

Figure 1. Trend in the number of fatalities and injuries where large trucks are concerned.

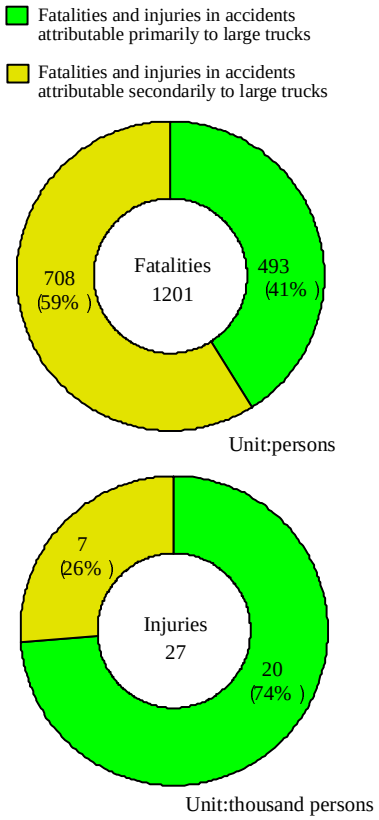

Figure 2. Number of fatalities and injuries classified according to the degree of fault by large trucks.

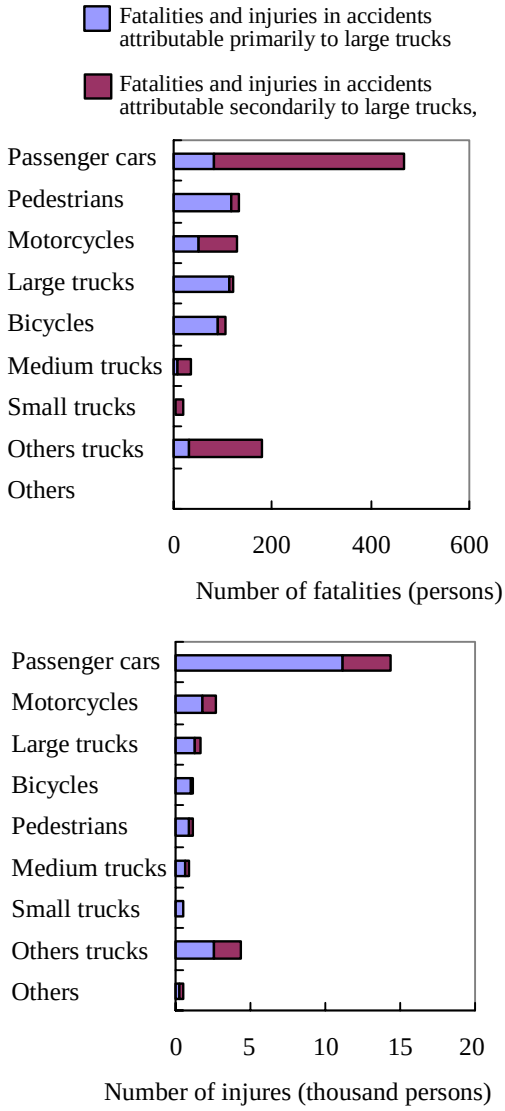

Figure 3. Number of fatalities and injuries where large trucks are concerned.

Analysis by human factor, road and environmental factor, and vehicle factor

If the number of fatalities and injuries were acquired upon classifying the causes of accidents into three --- human factor, road and environmental factor, and vehicle factor, almost all of the accidents would prove to be caused by the human factor, or drivers (See Figure 4). Further division of the human factor causes would clarify delay or lack of recognition as the main one, followed by errors in judgment as the second (See Figure 5).

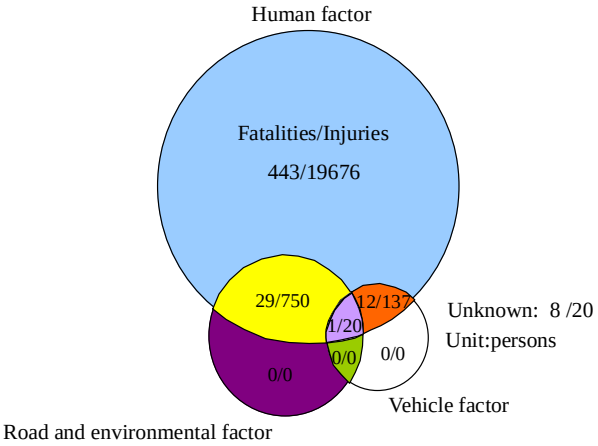

Figure 4. Number of fatalities and injuries in terms of human factor, road and environmental factor and vehicle factor.

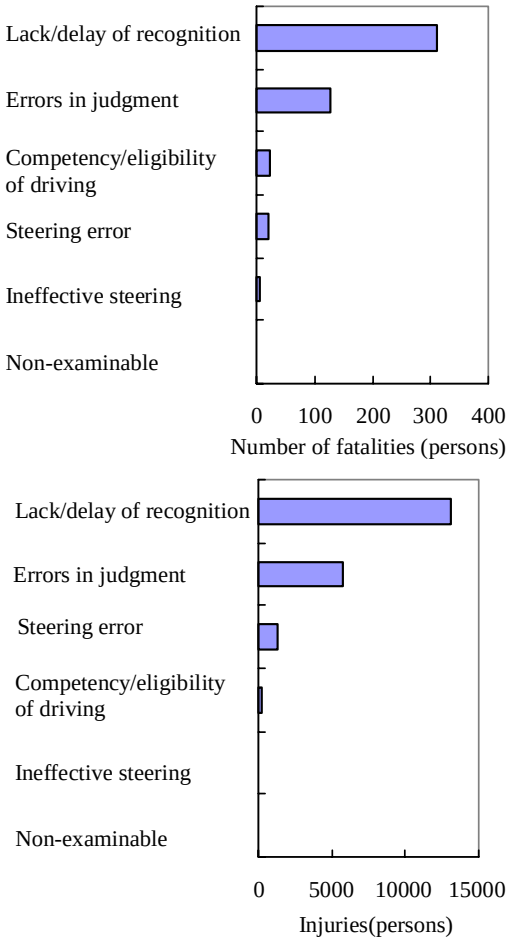

Figure 5. Number of fatalities and injuries in categorized errors of large-truck drivers.

Analysis according to those who are involved in accidents

Passenger Car Accidents

From the aspect of accidents, rear-end collisions bring about a large number of both fatalities and injuries (See Figure 6). Many of these are caused by stopped passenger cars being bumped by large trucks (See Figure 7), and most collisions are attributable to carelessness such as diverting one's attention from the road or errors in judgment (See Figure 8).

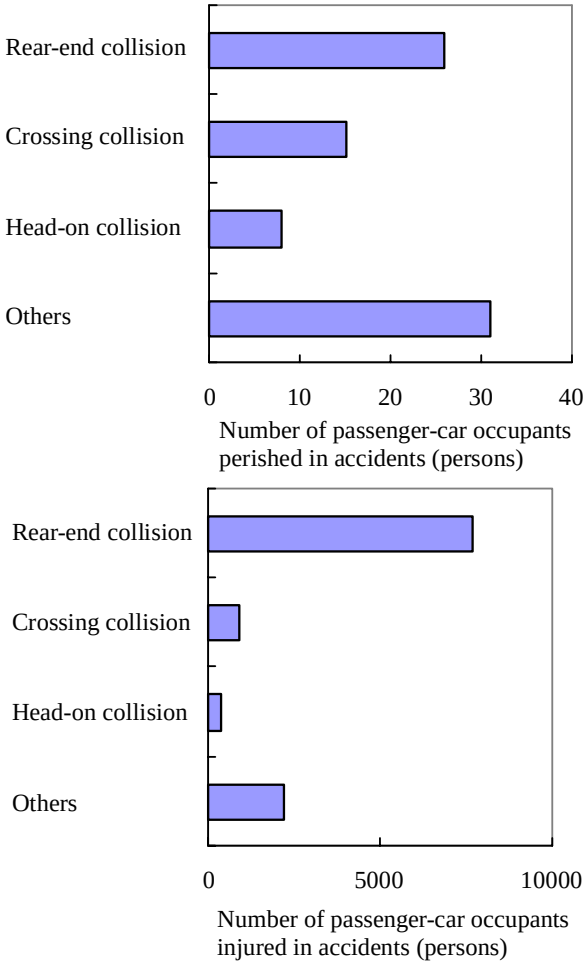

Figure 6. Number of passenger-car occupants perished and injured, categorized by types of accidents.

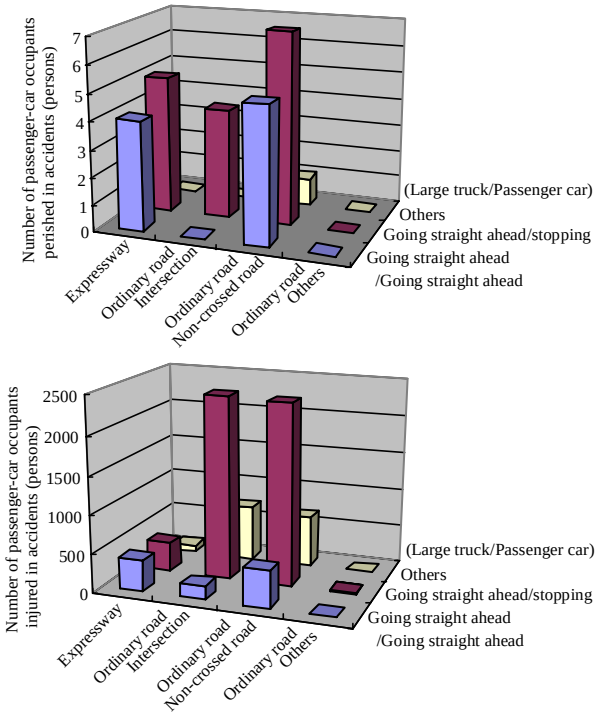

Figure 7. Numbers of passenger-car occupants perished and injured in rear-end collision, categorized types of road configurations and types of behavior.

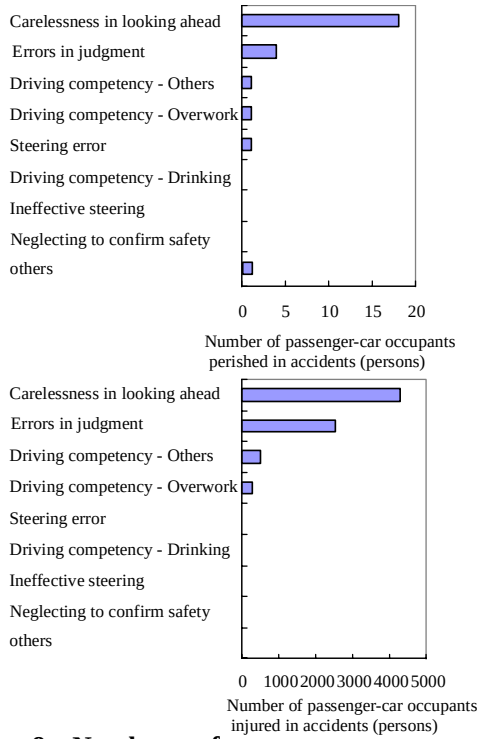

Figure 8. Numbers of passenger-car occupants perished and injured in rear-end collision, categorized by errors of large-truck drivers.

Pedestrian Accidents

From the aspect of accidents, pedestrians are at the greatest risk of death or injury while crossing roads (See Figure 9). Let's examine accidents that occur when pedestrians are crossing a road according to the behavior of large trucks. Many fatalities occur when large trucks are traveling straight ahead on non-crossed roads or at intersections, and mainly at night (See Figure 10). As for the human factor in accidents while large trucks are running straight ahead, Carelessness in looking ahead is the cause in many cases, followed by errors in judgment (See Figure 11). For ensuring on-time delivery and maximum transportation efficiency, large long-haul trucks in Japan travel mainly at night. Compared with daytime, nighttime travel is generally done at higher speeds whereby there is a greater risk of death in the case of an accident. Visibility is also poorer at night, and the assumption by the driver that pedestrians are probably not around at such an unusual time will tend to delay his or her recognition of a pedestrian. As for injuries, they often occur when making a right turn at intersections (See Figure 10). As a human factor in right-turn accidents, Neglecting to confirm safety takes up the greater part (See Figure 12).

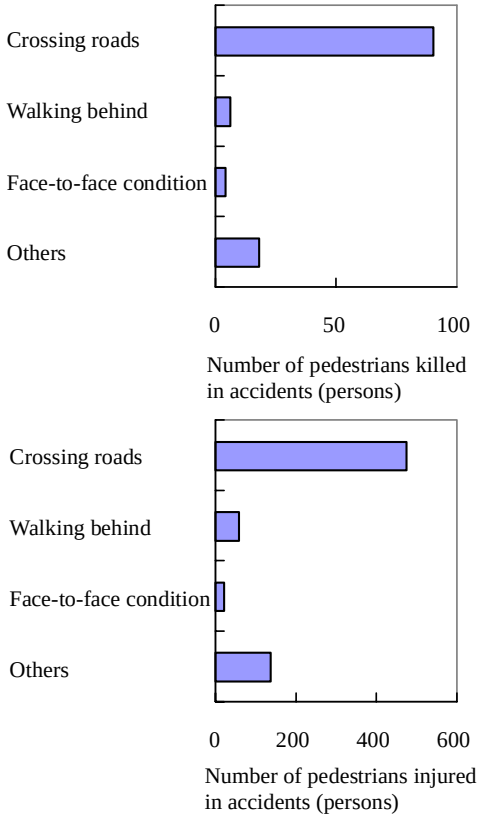

Figure 9. Number of pedestrians killed and injured in accidents categorized by type of accidents.

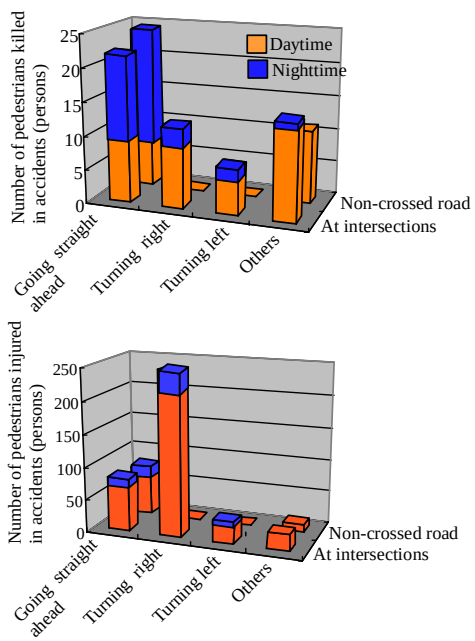

Figure 10. Number of pedestrians killed and injured in accidents while crossing roads, categorized in types of road configurations and types of large-truck behavior, based on categories of daytime and nighttime.

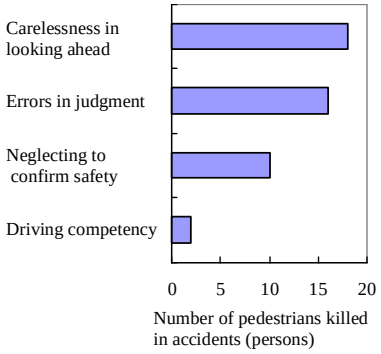

Figure 11. Number of pedestrians killed in accidents while going straight ahead, categorized by errors of large-truck drivers.

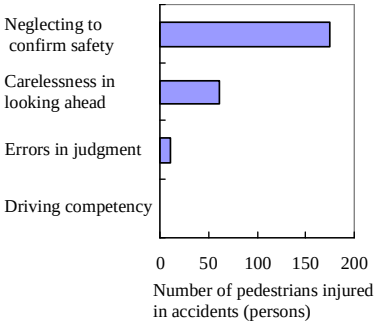

Figure 12. Number of pedestrians injured in right-turn accident, categorized by errors of large-truck drivers

Fatalities and Injuries to Large Truck Occupants

Rear-end collisions account for many of these accidents (See Figure 13). Fatalities in rear-end collisions often occur on expressways, and injuries on ordinary roads. According to the behavior aspect, large trucks often collide with stopped vehicles (See Figure 14). Most of the collisions are caused by carelessness such as the driver diverting his or her attention from the road (See Figure 15). Expressways of around 6,400 km in overall length support the physical distribution of goods by truck in Japan. Large long-haul trucks are the major means of distribution between important points via expressways, and driving on long monotonous expressways is likely to induce lapses of attention. It may also lead to accidental collisions.

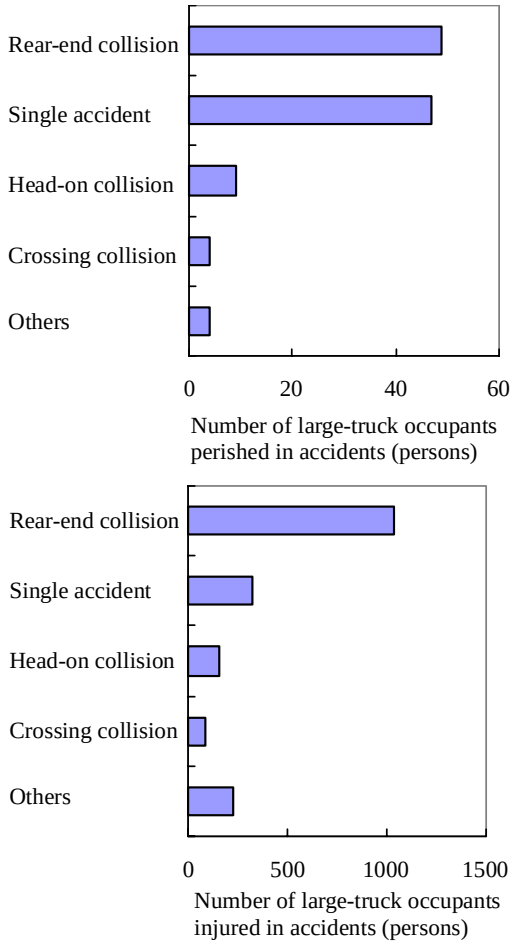

Figure 13. Number of large-truck occupants perished and injured in accidents, categorized by types of accidents.

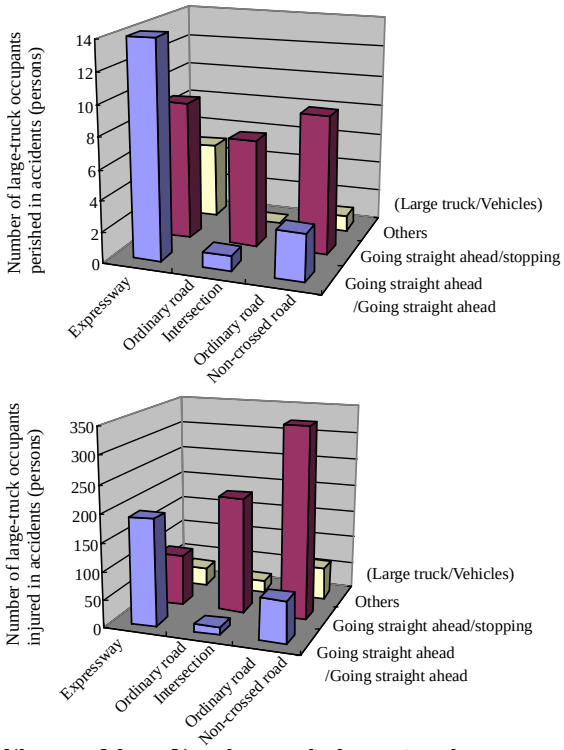

Figure 14. Numbers of large-truck occupants perished and injured in rear-end collision, categorized types of road configurations and types of behavior.

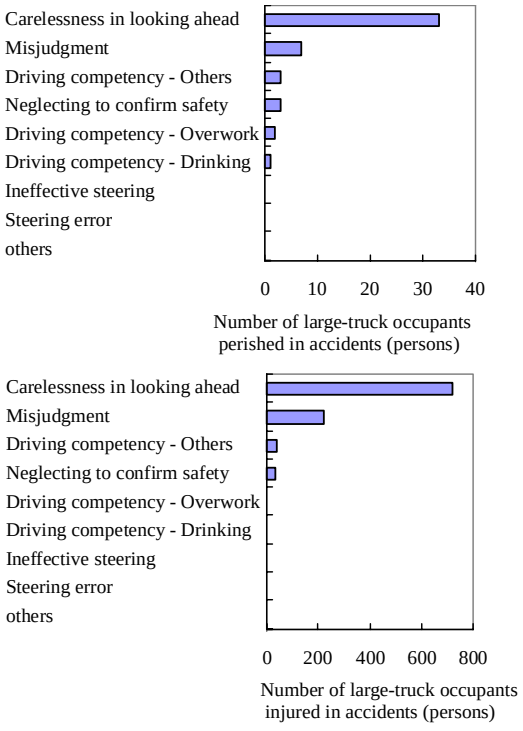

Figure 15. Numbers of large-truck occupants perished and injured in rear-end collision, categorized by types of large-truck drivers' errors.

Bicycle Accidents

According to road configuration, intersections are mentioned first as the site of fatalities as well as injuries (See Figure 16). Let's classify accidents at intersections according to behavior. In the case of both fatalities and injuries, bicycles moving straight ahead are often struck by large trucks making a left turn (See Figure 17). As a human factor in left-turn accidents, neglecting to confirm safety takes up the greater part (See Figure 18). Bicycles because of their smallness may be difficult to see from the cab of a large truck, which may be one of the factors leading to such accidents. While bicycles are regarded as vehicles by law, they are similar to pedestrians from the viewpoint of size. Safety measures will have to be studied from an overall viewpoint including the issue of whether bicycles should be allowed to travel on the same routes as large trucks.

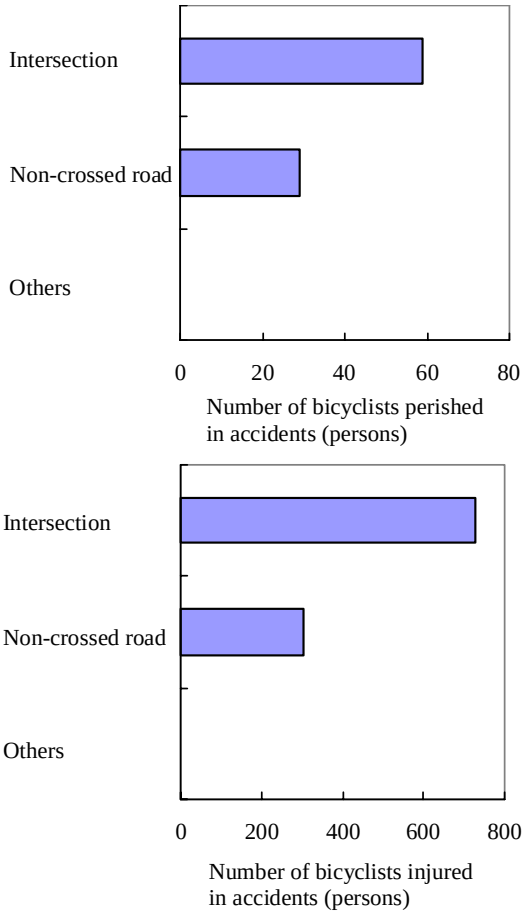

Figure 16. Numbers of bicyclists perished and injured in accidents, categorized in types of road configurations.

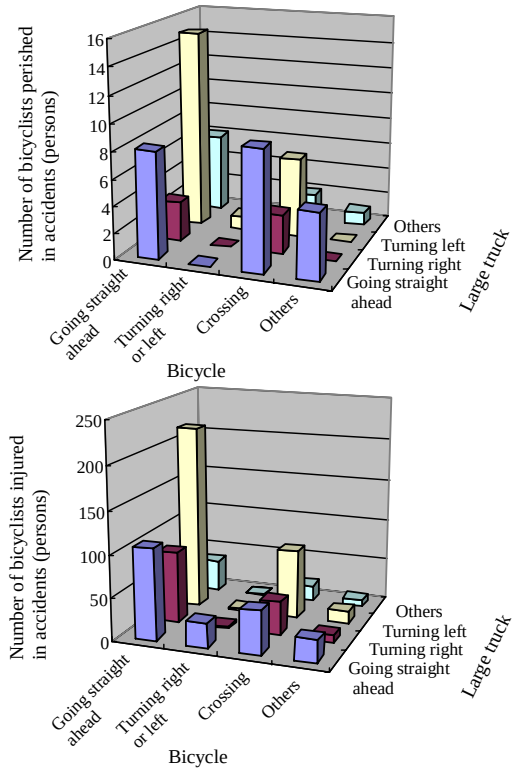

Figure 17. Number of bicyclists perished and injured in accidents at intersections, categorized by types of behavior.

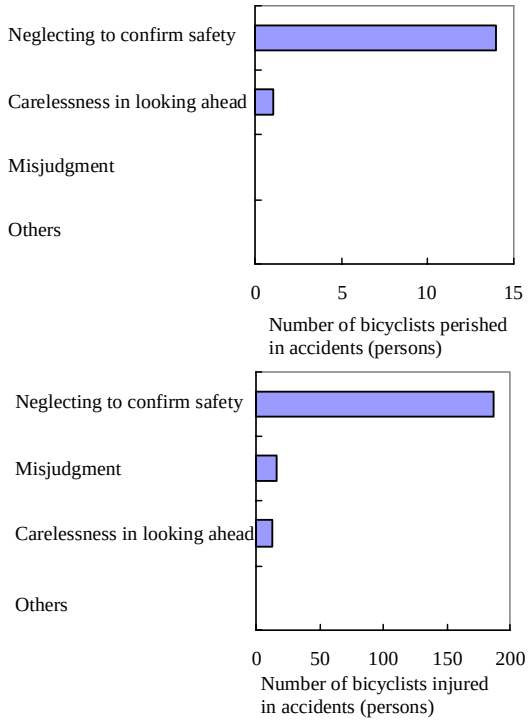

Figure 18. Number of bicyclists perished and injured in accidents while turning left at intersections, categorized by types of large-truck drivers' errors.

Motorcycle Accidents

Fatalities often occur at intersections in the case of motorcycle accidents also (See Figure 19). According to behavior, large trucks running straight ahead often collide with motorcycles that are also running straight ahead (See Figure 20). More than half of these are crossing collisions (See Figure 21). The sites of injury-causing accidents are intersections followed by non-crossed roads (See Figure 22). At intersections, accidents are often caused by making right or left turns without ensuring safety (See Figure 23), and, on-crossed roads, they often occur while running straight ahead, when changing lanes and when passing by misjudgment (See Figure 24). Motorcycles are sometimes hard to recognize since they easily blend into the background. And some people have pointed out that their relative position and speed tend to be misjudged. For safety measures with respect to motorcycles, it is important for people in other vehicles to be positively aware of their presence.

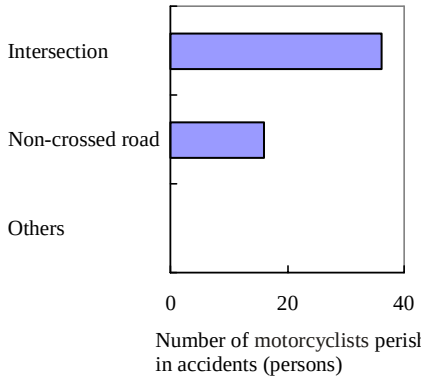

Figure 19. Number of motorcyclists perished in accidents, categorized in types of road configurations.

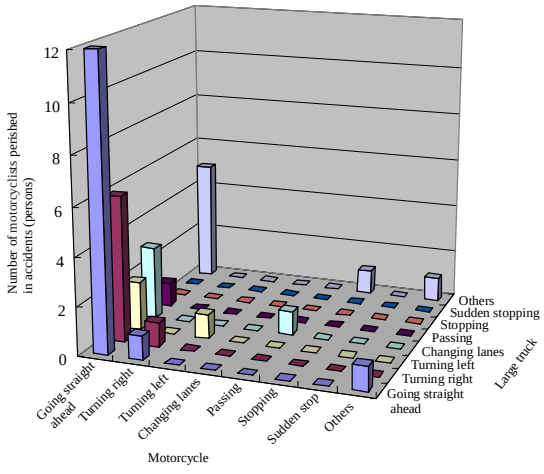

Figure 20. Number of motorcyclists perished in accidents at intersections, categorized by types of behavior.

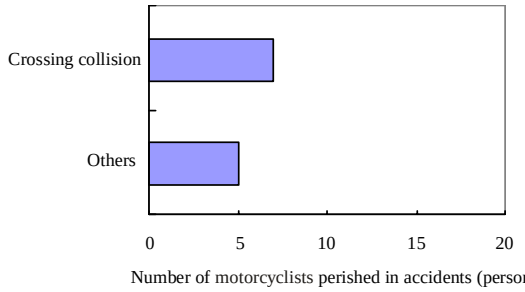

Figure 21. Number of motorcyclists perished in accidents while going straight ahead at intersections, categorized by types of accidents.

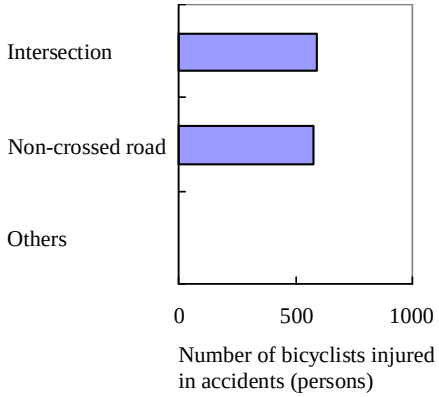

Figure 22. Number of motorcyclists injured in accidents, categorized in types of road configurations.

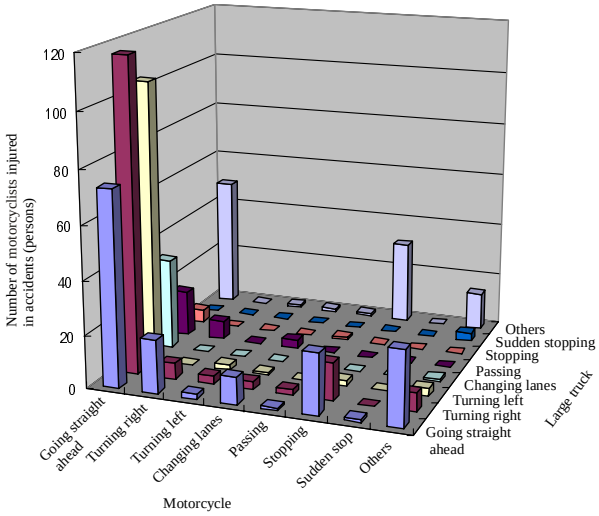

Figure 23. Number of motorcyclists injured in accidents at intersections, categorized by types of behavior.

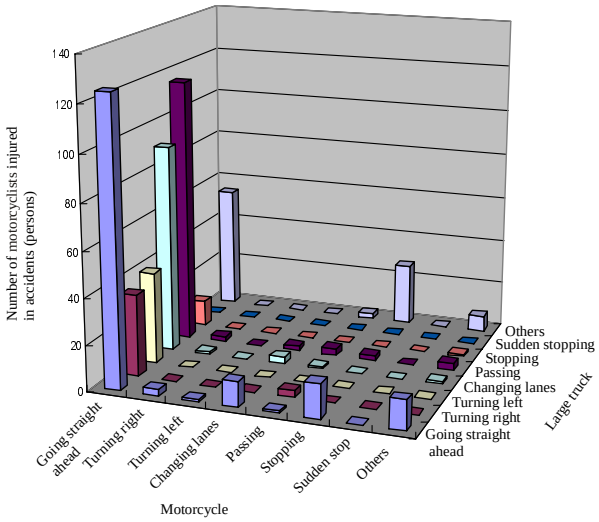

Figure 24. Number of motorcyclists injured in accidents at non-crossed roads, categorized by types of behavior.

DIRECTION OF COUNTERMEASURES

Safety measures presuppose an overall approach of substantiating three phases --- driver training, infrastructure, and vehicle hardware. The training may have to include safety education so as to avoid causing, and also to avoid being involved in accidents. The infrastructure must be widely discussed including the installation of separate signals by which vehicles are kept waiting while pedestrians are crossing a road, and the provision of lanes exclusively for bicycles. Since the revision of the Road Traffic Control Law in 2002, the number of fatalities is recognizably smaller than in the previous year. In order that the safety measures will be effective, the promotion of regulations will have to be discussed while obtaining a wide-ranging consensus. To prevent vehicles from causing accidents, the fundamental performance of vehicle hardware must be improved above all. Shortening the braking distance versus truck weight and alleviating the fatigue inherent to long-haul runs are fundamental and important issues. Accidents that could not be avoided by improvement of the basic performance of vehicles alone will have to be dealt with by resorting to ASV; Advance Safety Vehicle techniques and other safety systems to be improved and/or newly developed. In order that conceived safety measures will bring about fruitful results, it is important to extend the safety systems over a wide area. And in the development of products hereafter, it is necessary to realize both safety and economy for the user and to make the products available not only for new vehicles but for vehicles already in use. The following provides a direction for safety of vehicle hardware with respect to each of the categories

mentioned in the foregoing.

Passenger Car Accidents

To avoid collisions with passenger cars, one can consider using the collision warning system and the forward collision avoidance assistance system.

Pedestrian Accidents

To protect pedestrians crossing a road, a pedestrian detecting technique must be developed. "Night vision" will be effective for preventing accidents at night. For preventing accidents at intersections, a pedestrian detection system resorting to pyroelectric sensor or ultrasonic waves can be envisaged. It is advantageous to eliminate protrusions on the front of a truck and provide an energy absorbing body structure for minimizing damage to pedestrians in the event of an accident.

Fatalities or Injuries to Large Truck Occupants

As countermeasures for Rear-end collisions, the collision warning system which is already placed on the market and the forward collision avoidance assistance system can be considered. For minimizing damage to truck occupants in the event of an accident the vehicle body must be designed to ensure a proper mechanical strength and also, from the viewpoint of collision dynamics, a structure for transmitting the impact energy to engine, chassis, etc. will have to be devised.

Bicycle Accidents

For reducing bicycle accidents when making a left turn, a left-rear vision aid and a rear alarm can be considered. For preventing bicycles from being caught under a vehicle, a system of automatically braking upon contact with a bicycle, a front tire guard, etc. will have to be studied.

Motorcycle Accidents

To cope with crossing collisions, or accidents when making a right turn, when passing or when cutting in and out of traffic, the use of a car-to-car communication technique may be considered. And to avoid accidents when changing lanes, a left-rear vision aid and rear alarm may be helpful. The installation of marker lamps that are easily noticed by others, and other improvements of visibility on the part of motorcycles are also important.

CONCLUSIONS

Safety measures start with understanding the true causes of accidents. Effective safety systems will be researched and developed by taking a multilateral approach toward accidents from the viewpoints of people, the environment, and vehicles.

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[2] Meeting for reporting results of second promotion plan for advanced safety vehicles – Road to safe automotive society by ITS – Ministry of Land, Infrastructure and Transport